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Research paper

Evaluation of surface water quality for drinking purposes using fuzzy inference system

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ABSTRACT

The aim of this research is to propose a surface water quality index using fuzzy inference system. Three stations and ten parameters (pH, TDS, Ca, Mg, Na, K, Cl, SO_4, SO_4 and HCO_3) are selected from Oued El Hai Basin of Algeria to develop the approach. The results show that calcium and sulfate are the dominate ions in the three stations. TDS is strongly and positively correlated with SO_4 and HCO_3. From ANOVA test, there are no significant differences for all parameters except Ca and K in terms of their temporal variation. Water-rock interactions and anthropogenic process are the main factors that are controlling the surface water quality. The water quality index is assessed with the FWQI index, and the results show that the values of WQI and FWQI have similar characteristics regarding the water quality index.

1. Introduction

Water is an essential factor for the whole life and the human survival and, having an important role for both drinking as well economic sectors. Therefore, protecting this source against any pollution has become necessary (Witek and Jarosiewicz, 2009; Reza and Singh, 2010; Sojobi, 2016). In the last century, the availability and quality of surface or ground waters have been changing, mainly due to urbanization, industrialization etc.

The water quality can be assessed using physico-chemical parameters, the harmful limits of those for human health being established at international or national scale (WHO, 2004). The best way to express the quality of water resources for consumption is the Water Quality Index (WQI). Using the water quality data being useful for the modification of the policies (Yang and Wang, 2010; Mohemmad et al., 2011; Tyagi et al., 2013; Tiri et al., 2014). The Water Quality Index (WQI) is one of the most effective tools by which water quality data are summarized and well presented, but the parameters of the water quality index are to be calculated in order to prepare the surface water has drinking water use, the gap between WQI parameters and the uncertainty in the quality criteria used and common (Khan et al., 2003; Soroush et al., 2011; Tirkey et al., 2016).

The limitations of WQIs demonstrate the need to develop techniques and more advanced assessment methods which enable the analyst to include and interpret qualitative and quantitative information. The methods based on fuzzy inference system (FIS) can combine the advantages of the traditional methods with the advantages provided by the FIS.

In classification schemes, fuzziness makes the use of sharp boundaries hard to justify. A small increase/decrease in pollutant data, near its boundary value, will change its class. Many researchers demonstrated that the fuzzy logic method was mainly used to solve problems related to water resources (Araghinejad, 2014). In modeling complex of environmental problems, researchers often fail to make precise statements about inputs and outcomes of parameters, but fuzzy logic could help to overcome these logical uncertainties. Fuzzy logic can be considered as a language that allows one to translate sophisticated statements from natural language into a mathematical formalism. Fuzzy logic can deal with highly variable, linguistic, vague and uncertain data or knowledge and therefore has the ability to allow a logical, reliable and transparent information stream from data collection to data usage in environmental application system. Fuzzy logic provides a powerful and convenient formalism for classifying environmental conditions and for describing both natural and anthropogenic changes. Also, fuzzy logic can be used to classify and quantify environmental effects of a subjective nature, and it even provides a formalism for dealing with missing data. Lermontov et al. (2009) developed a fuzzy WQI (FWQI) to assess the quality status. The results on water quality obtained using the index developed on the basis of fuzzy set theory were found to be more useful than those derived from the Water Quality Index method that is

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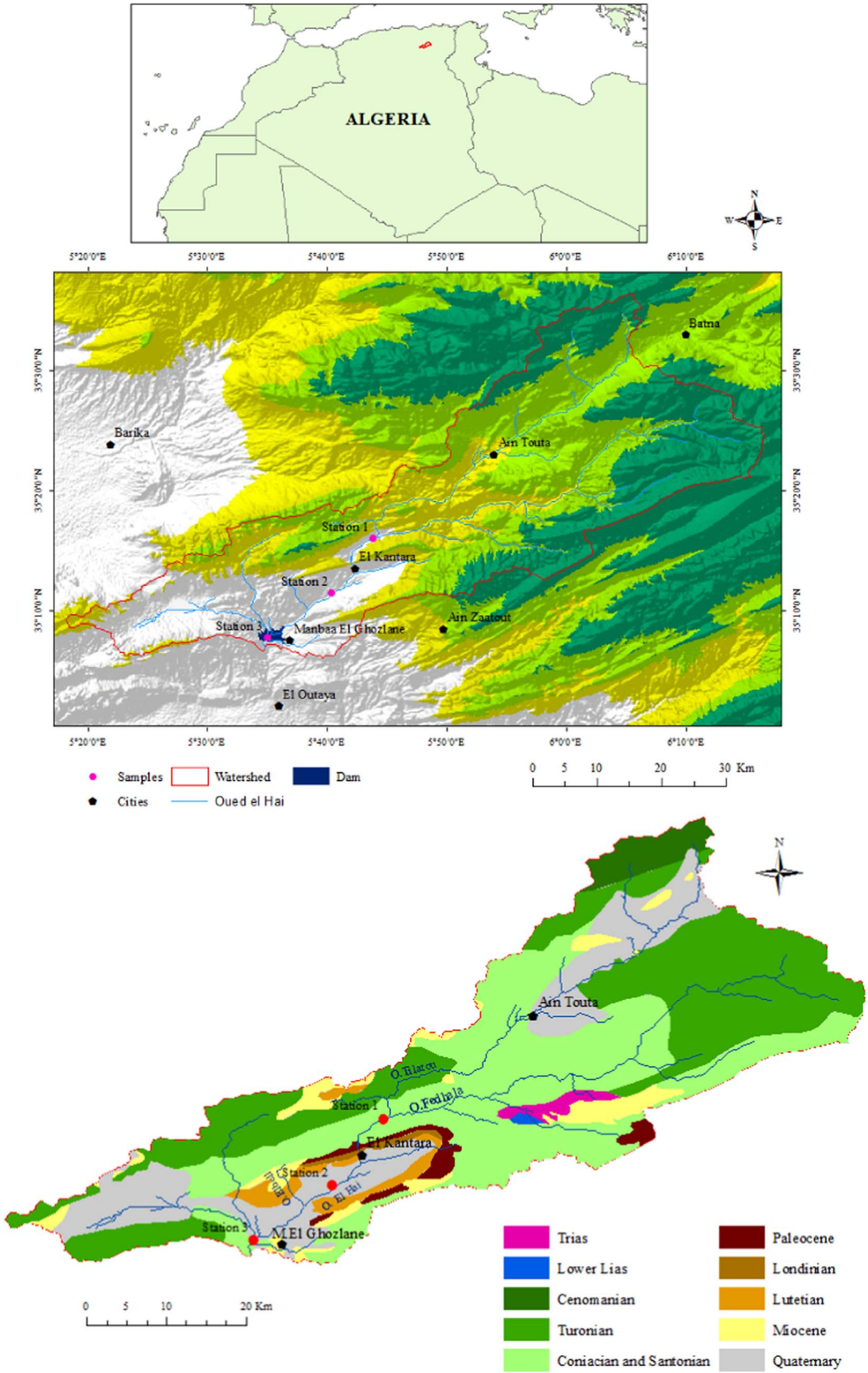

Fig. 1. Location and geology of the study area.